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Evaluation of the Efficacy, Feasibility and Flexibility of a New Rehab-Protocol as a Fundamental Part of Conservative Treatments for Ankle Traumas

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Abstract

Introduction: Ankle traumatic injuries represent a predisposing condition for functional deficits, such as stiffness, residual pain and abnormal functionality, which may reduce return of patients to the activity-levels before the trauma. Several types of treatment have been proposed, and lots of studies and reviews of the last years have emphasized the importance of proper rehabilitation and re-educational programs in order to permit a safe and complete recovery.Objective: The aim of this study is to assess the efficacy and feasibility of an original program of "Functional" physiotherapy and active exercises after an acute treatment for the most common ankle injuries Materials and Methods: Our study was conducted on 40 patients who reported two different types of trauma: both lateral ankle sprain, 2 nd and 3 rd degree of injury, or not displaced ankle fracture. All the patients attended at the same "Functional" rehab-protocol.

Index terms— ankle trauma; conservative treatment; ankle rehab.

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Objective: The aim of this study is to assess the efficacy and feasibility of an original program of "Functional" physiotherapy and active exercises after an acute treatment for the most common ankle injuries Materials and Methods: Our study was conducted on 40 patients who reported two different types of trauma: both lateral ankle sprain, 2 nd and 3 rd degree of injury, or not displaced ankle fracture. All the patients attended at the same "Functional" rehab-protocol. AOFAS score and TEGNER scale submitted to patients in order to assess the clinical conditions at time zero (T0) and current ones at time t (T1), after 4 months **??**15-18 weeks).

Results: In the group of patients with sprain, AOFAS at T0 reported an average score of 41,70. After the treatment (T1), the score of AOFAS for this group was 93,86. In the other group, results of AOFAS at T0 have shown an average score of 41,76. After the treatment (T1) value of score was 89,6. Regarding Tegner Activity Scale, we observed that all patients who have reported ankle sprain have returned to the same level of activity they held before the trauma. No recurrences of the pathology happened. Conclusions: Our "functional" rehab-protocol, despite the limits of the study, has been proven to be flexible and efficient. Finally, results of the studies show how the protocol could be feasible in different types of ankle pathologies.

1 I. Introduction

nkle sprains, especially lateral sprain, and ankle fractures are some of the most common musculoskeletal injuries in sport activity [1].

Although ankle sprain with ruptures of the ankle ligaments are very common, treatment selection remains controversial.

After a proper diagnosis, it is generally agreed that non-operative treatment with early functional rehabilitation is the gold standard among treatments. **??**2;3].

Surgical treatment has been shown to be associated with increased risk of complications, and higher costs too [4].

Ankle fracture represents probably the most common fracture of lower limbs [5].

Depending on the severity, choice for fracture can vary among surgical or conservative treatments. Despite the selective treatment, fractures lead to several mid-term and long-term complications or residual deficits [6].

Mid-term and long-term complications might be potential problems in all the ankle traumas, including the immediate impact on mobility and risks associated with prolonged immobilisation such as muscle atrophy, deep vein thrombosis and joint stiffness. Long-term consequences might include prolonged gait abnormalities, muscle weakness, altered range of motion and an inability to return to previous activity levels [7]. Then, it is well known that any biomechanical abnormality of the foot-ankle complex is potentially able to influence a sport-man functionality, predisposing him to a lesser or greater extent to injuries. So this kind of long-term complication could lead to a compromising quality of life [8].

Generally, after the acute treatment for an ankle injury, the re-educational treatment plays an important role in order to get a proper functional recovery. The common target of rehabilitation is to improve muscle strength, range of motion (ROM) and sensorimotor control [9].

Several rehabilitation approaches are currently used to manage the effects of an ankle sprain or fracture [10]. Lots of RCT and reviews have been written about the effectiveness of different forms of interventions in acute ankle sprains [11]; a large number of discussions have been also presented in literature about the effectiveness of the different types of treatments for ankle fractures (malleolar/bimalleolar/trimalleolar) [12]. Though, recent reviews and meta-analyses seem to agree about the importance of "functional" treatment, as probably the most effective approach **??**3;13;14]. Despite all the proposed options, it is not commonly approved which treatment could be the most appropriate. Every type of injury seems to be correlated to different principles of treatment, rehabilitation and reeducation protocols.

Absolutely few RCT have discussed about the possibility of founding rehab guidelines that could be common to the different ankle traumatic pathologies.

2 II. Aim of the Study

The objective of this study was to assess the efficacy of an original program of "Functional" physiotherapy and active exercises after an acute treatment for the most common ankle injuries. Then, feasibility of the protocol for different types of trauma is evaluated, in order to propose a standardization of the rehab-program for a functional recovery for every kind of trauma, grade of trauma and type of treatment (conservative or surgical). Variability in types of injury, severity of injury and type of patients create the variability in timing and duration of the several phases that we propose.

3 III. Materials and Methods

4 a) Subjects of the study

Our study was conducted on 40 patients who reported two different types of trauma: both lateral ankle sprain, 2 nd and 3 rd degree of injury [15], and not displaced ankle fracture (malleolar; bimalleolar). All these patients have been treated with a conservative treatment. Exclusion criteria included bilateral injuries, inflammatory diseases, neurologic previous disorders, excessive obesity, displaced fracture, non-unions of fractures. Both two groups have been homogenous for age and BMI (Table **??**.).

5 Exclusion criteria

Selective criteria? BILATERAL INJURIES ? INFLAMMATORY DISEASES, ? NEUROLOGIC DISORDERS ? EXCESSIVE OBESITY ? DISPLACED FRACTURE ? NON-UNIONS OF FRACTURES ? COMPLICATIONS OF FRACTURES ? 1 ST AND 2 ND DEGREE OF ANKLE SPRAIN ? SURGICAL TREATMENT ? 18< AGE<55 ? 20< BMI<28 ? COMPLIANT PATIENTS ? ANKLE SPRAIN OF 2 nd AND 3 RD DEGREE ? MALLEOLAR/BI-MALLEOLAR FRACTURES Fig. 1: Selective criteria.

Basing on the exclusion criteria, a careful and precise selection was made, which resulted in a total of 40 patients who fully complied with the criteria. 20 of 40 patients fell in the first group, with second and third degree of ankle sprain (A); the other 20 patients, who reported ankle fracture treated in a conservative manner, fell in the second group (B).

In the first group (A) there were 13 male and 7 female patients, with a current average age of 35.5 years (40.6 for females and 32.8 for males).

In group B there were 10 males and 10 females, with an average of years 38,5 (41,8 for females and 35,2 for males).

Two evaluation charts of "clinical score" type were submitted to patients in order to assess the clinical conditions at time zero (T0) and current ones at time t (T1), after 4 months (15-18 weeks). . The AOFAS score and TEGNER scale were used.

To correspond to the end of acute phase of the treatment and proper Rehab phases of protocol are assessed.

Patients with sprain (Group A) started a progressive load-walking about 10-20 days after the trauma in case of 2 nd degree-sprain and 15-30 days in case of 3 rd degree-sprain.

Patients with fracture have been treated with a cast and no walking for 5 weeks. After the removal of cast a progressive load-walking with the use of a bivalve brace for other 15 days has been recommended. The first assessment at T0 was carried out after the removal of the appliance cast.

6 b) Evaluation Tools

American Orthopedic Foot and Ankle Society (AOFAS) scale: items are distributed into three major categories of pain, function and alignment. Each item included was based on both subjective and objective assessment and is scored from clinical observation and finding. The maximum score is 100 points [16].

The TEGNER is a scale graded activity based on work and sports activities. It is important in order to measure both function and activity level [17].

7 c) Protocol of Rehab/Re-Educational treatment

The protocol used both for patients with sprain and for those with fractures has been assessed by our Orthopaedic institute of University of Perugia; the objective of this protocol is a complete "functional recovery". All the patients attended to the same protocol.

It consists in 5 phases. The first one is the treatment for acute pathology. The other phases are the proper rehabilitative and re-educational phases. Passages from a step to the sequent one vary in timing. This variability derives from different morphotypes, compliance and athletic conditions before the trauma of the patients. The passage into the next phase should be granted only when the patient is able to conduct the previous one without pain and in proper way.

All exercises in the treatments should be practiced 3-4 times/day, 20-30 minutes for each one. Step 2: subacute phase (Fig **??**)

Timing: The transition from phase 1 to phase 2 is established on the basis of an orthopedic control visit: if the patient is able to walk with a bearable pain, it passes in this stage, otherwise it prolongs the phase for 1 to 5 days. Duration: 7-10 days Treatment 1. Progressive load as a function of pain, always with ankle brace. ? Flex and extend fingers with a towel (put a weight on the towel to increase resistance).

? Grasp objects with fingers (fabrics, marbles).

? Proprioceptive tablets.

? Stretching.

? ROM passive -only dorsal and plantar flexion in painless range, not supination or pronation.

? Achilles tendon stretching (cautious).

? Joint mobilization (in grade 1 and 2 in dorsal and plantar flexion).

8 Table 4:

Step n° 3 of the protocol.

9 Table 5:

Step n° 4 of the protocol.

Step 4: Functional re-education

10 Duration: variable

Treatments:

1. Continue with the progression of the ROM and strengthening exercises.

11 :

Step n° 5 of the protocol.

Step 5: preventive phase Aims: Preventing injuries. Functional exercises:

? Activities multidirectional balance tablets.

? Preventive reinforcement (insisting on the peroneal pronation). Back to competition for Sport-people

? The athlete can return to training when all the exercises are performed at maximum speed.

? Can resume the competition when all training is tolerated.

Optional: Dynamic bandage.

For No sports / elderly

? Correct gait pattern ? Proprioceptive Rehabilitation

12 IV. Results

We scored the clinical evaluations by AOFAS score for Ankle both at T0 and at T1.

We present in the table below (Table 7) the results for AOFAS score, both at T0 and T1, for patients with ankle sprain.

Values associated to the items correspond to percentages of patients.

In group A, results for patients at T0 have shown an average score of 41,70

After the treatment (T1), the score of AOFAS for this group was 93,86 (Fig. **??**). Fig. **??**: Improvement of AOFAS score for Group A.

As we can see in the graphs, almost all the patients have reported at T1 a good improvement in all the items. Function-items seem the best, while alignment and pain, in some cases, are still evident at T1 (Fig **??**; In the table below (Table 8) the results for AOFAS score, both at T0 and T1, for patients with fractures (Group B) are reported.

Values associated to the items indicate the percentages of patients. Results for Group B show a good improvement in all the items. As we can see, items such as pain, maximum walking distance and alignment have shown poorer results respect group A (Fig. 6). Regarding Tegner Activity Scale, in the group A, while 71% of Patients were sport-people (level 7/8), the other 29% of people had a sedentary lifestyle (level 1-2) before the trauma.

In group B, 52% of patients were sport-people (level 6-8); 32% of them were assessed in level 3-4; the remaining 16% of the patients were used to observe a sedentary lifestyle (level 1-2).

At the final stage, after the complete rehabprotocol, we observed that all patients who have reported ankle sprain, have returned to the same level of activity they held before the trauma.

In Group B (ankle fracture) 15/20 patients are back at the previous levels before the trauma, 4 are back at a lower level, from high levels to level 3; only one patient has gone down to a Level 1 from level 4.

Anyway, in both the groups evaluated, at followup of 12 months, no recurrences of the pathology happened.

13 V. Discussion

In the era of evidence-based medicine (EBM), for maximum results, guidelines arising from the analysis of the international literature are indispensable. These should be also mediated by the experience of the individual professionals involved and by periodical checking of quality of their work. A proper protocol of rehabilitation and re-education should vary in qualitative and subjective criteria; anyway these criteria should proceed with quantitative parameters (measurements, biomechanical testing, objective evaluation boards and validated at the international level) [2;12].

Several protocols have been developed for rehabilitation after both acute severe ankle sprains, and ankle fractures **??**8;18;19]. Their principal target is the management of pain, swelling, range of motion, strength training, and proprioceptive training. Every rehabilitation protocol has the target of a fast and safe return to the preinjury activity level [20] The rehabilitation program should be divided into several stages, with goals set for each stage. Parameters for every stage must be reached before moving on to the next phase: rehabilitation must proceed with periodic comparisons between rehabilitation therapist, physiatrist and orthopaedic. It is important that these professionals have specific experience in the treated disease.

Few RCT and reviews report protocols divided in stages. While this type of programs is common for other district, such as knee [21], for ankle few precise flow-charts of phases for rehabilitation exist. Recently, Brison et al. have proposed a protocol in 4 phases with good results. In this study they also analysed the effectiveness of an early supervised physiotherapy reporting no significant differences respect the classical ways [22].

In our protocol 5 stages have been created with proper methods, treatments, and targets. Obviously, timing and duration of every stage cannot be rigid and fixed. It should vary according to the type of patient and compliance.

Then, the concept of functional recovery has grew-up in the last years. The most recent metaanalyses, such as the Cochrane works have shown how the complete rehab-programs whose target is the functional represent the best approach **??**3;13;14].

In our program we emphasize the stages of active and assisted-active exercise for functionality. The target of our protocol is not limited neither to the recovery of mobility alone nor of neuro-muscular activities Coordination between them are expressed in the 4 th phase, which represents the phase of "functional recovery".

Also the evaluation tools of the study (AOFAS and TEGNER) are scores that maybe better than others are able to evaluate functionality. We get good results in this pattern for both the group, but with some small difference among them. As we can see, items such as pain, maximum walking distance and alignment have shown poorer results respect group A, we think because of the different involvement of anatomical structures for the two pathologies. In fact, for fractures, lots of studies report a greater number of mid-term and long-term complications than ankle sprain **??**6;10]. The ideal situation is definitely that one where you have available parameters acquired prior to the acute event occur; alternatively you can collect data before any surgery or before the beginning, during and at the end of rehabilitation, then in the follow -up controls at a later date after the resumption of activity There are some limits into our study: for example we have been able to evaluate the protocol for two different type of severe injury, but they are not alone; we have evaluated only patients who have

been submitted to a conservative treatment: future direction of the research is towards patients treated with surgery.

Finally, we didn't evaluate professional sportive people.

14 VI. Conclusion

Rehabilitation and re-education play a key role in the treatment of ankle sprain and ankle fracture, especially for their consequence: the joint instability. The main objectives are control of pain and swelling, the recovery of ROM, muscle strengthening, the neuromuscular control, the return to the same level of sport that was practiced before the trauma. These objectives must be achieved respecting the biological time of healing of anatomical structures that have been damaged. We propose in this study an original reeducational protocol for rehabilitation treatments in some of the most common ankle traumatic pathologies. It has been proven to be flexible and efficient. We think that no contraindications are connected with this kind of approach. The protocol can vary in timing and methods, depending on the type of sprain, possible instability or broken syndesmosis ankle -peroneal, type of treatment and type of patient (age, motivation, type and level of sport activity, environmental situation).

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Figure 1:

[1] [2]

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Figure 2:

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Figure 3: Fig. 1 :Step 3 :Fig. 2 :

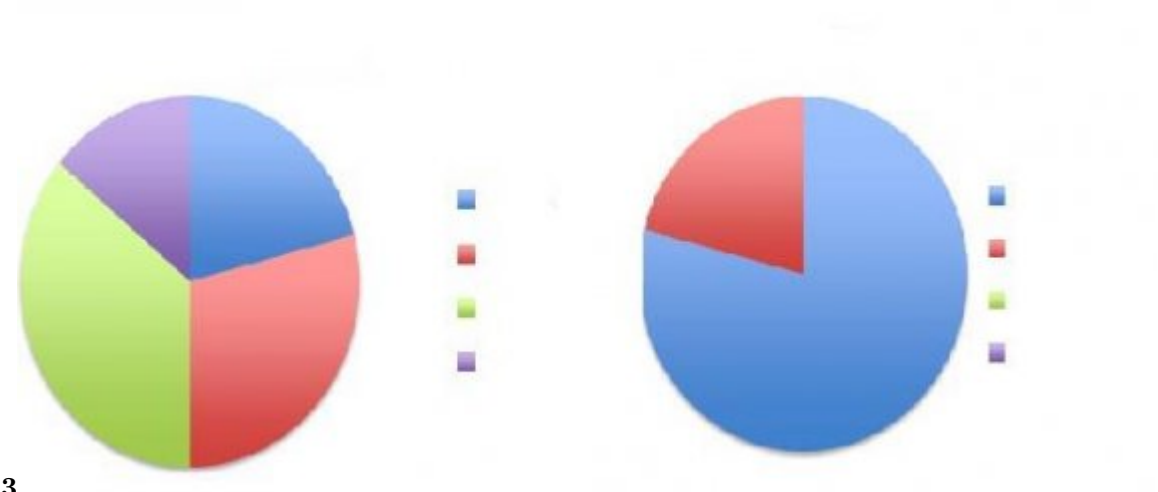

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Figure 4: 2 .Fig. 3 :

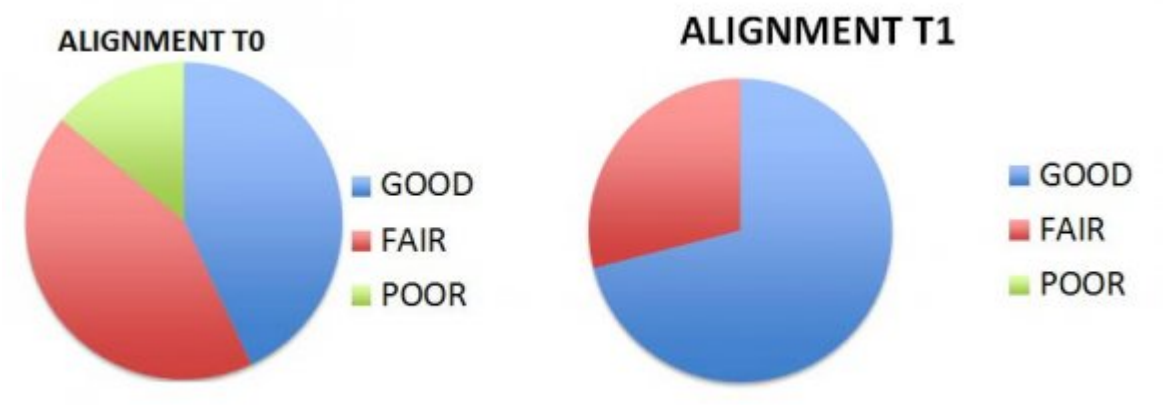

Figure 5:

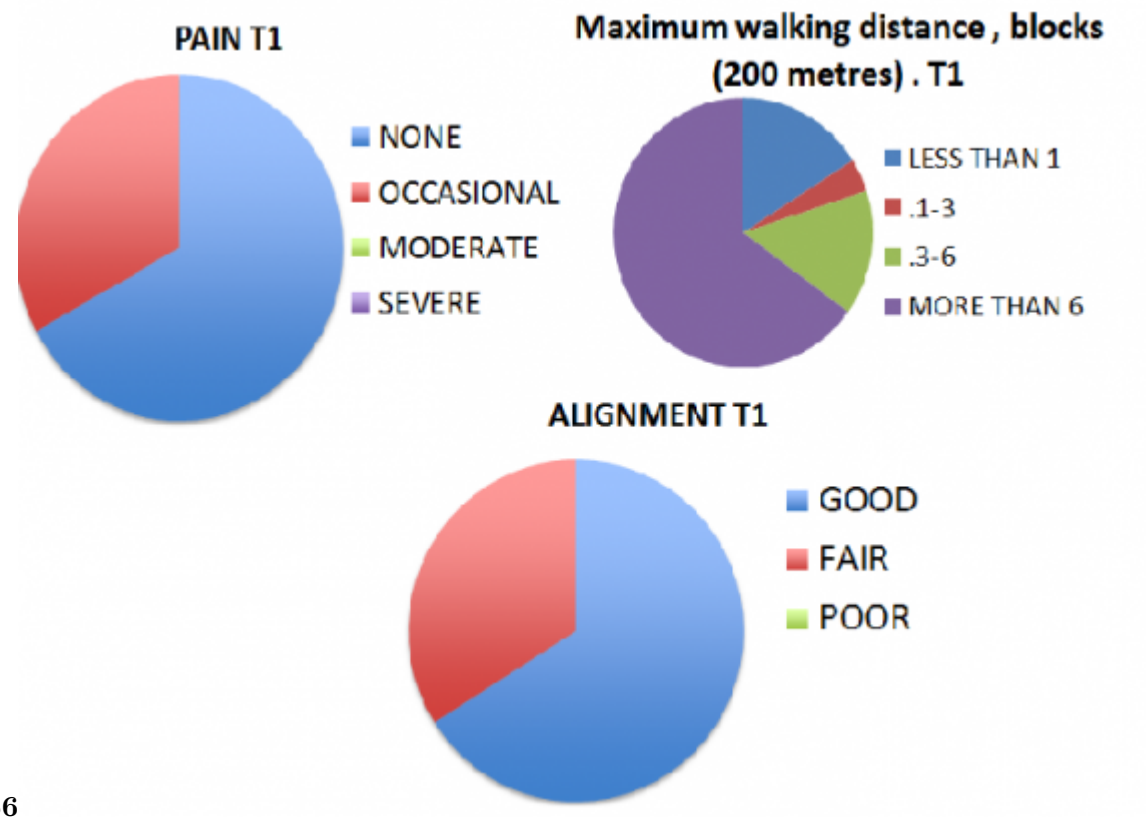

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Figure 6: Fig. 5 :KFig. 6 :

2

Step 1: Acute phase
Timing: From the trauma
Duration:
? Grade 2 Sprain: 10-20 days.
? Grade 3 Sprain: 15-30 days.
? Akle fracture: 5 weeks.
Treatments:
1. Load Prohibition (Canadian crutches)
2. Ice
3. Elevation
4. Venous pump Exercises
5. Optional: Zinc oxide cream
6. Optional: ankle brace (es. Aircast)
7. Optional: NSAIDs
8. Cast (for fracture)

Figure 7: Table 2 :

3

Figure 8: Table 3 :

7

AOFAS SCORE for ANKLE. Group A	T0	T1
Pain (40 points)		
None	21	79
Mild/Occasional	29	21
Moderate/Daily	36	0
Severe, almost always present	14	0
Function (50 Points). Activity limitatios, supports.		
No limitations, no supports	13	86
No limitations of daily activities, limits of recreation.	29	7
Limited daily and recreational activities	29	7
Severe limitation of daily and recreational activities, cruches, brace	29	0
Maximum walking distance , blocks (200 metres)		
Greater than 6	0	86
4-6	0	12
1-3	29	2
Less than 1	71	0
Walking surfaces		
No difficulty on any surface	0	79
Some difficulty on difficult surfaces	43	21
Severe difficulty on difficult surfaces	57	0
Gait abnormality		
None, slight	1	86
Obvious	30	14
Marked	69	0
Sagittal motion		
Normal or mild restriction (30° or more)	36	86
Moderate restriction (15°-29°)	43	14
Severe restriction (less than 150°)	21	0
Hindfoot motion (inversion plus eversion)		
Normal or mild restriction (75%-100% normal)	0	92
Moderate restriction (25%-74% normal)	20	8
Marked restriction (Less than 25% normal)	80	0
Ankle-hindfoot stability (anteroposterior, varus-valgus)		

Figure 9: Table 7 :

8

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AOFAS SCORE for ANKLE. Group B Pain (40 points) None	T0	T1
Mild/Occasional Moderate/Daily Severe, almost always present Function (50 Points). Activity limitatios, supports. No limitations, no supports No limitations of daily activities, limits of recreation. Limited daily and recreational activities Severe limitation of daily and recreational activities, cruches, brace Maximum walking distance, blocks (200 metres)	12 29 46 13 3 39 25 34	67 33 0 0 76 17 7 0
Greater than 6 4-6	0 0	65 15
1-3	18	4
Less than 1	82	16
Walking surfaces		
No difficulty on any surface	0	65
Some difficulty on difficult surfaces	48	26
Severe difficulty on difficult surfaces	52	9
Gait abnormality		
None, slight	0	65
Obvious	15	35
Marked	85	0
Sagittal motion		
Normal or mild restriction (30° or more)	16	78
Moderate restriction (15°-29°)	55	22
Severe restriction (less than 150°)	29	0
Hindfoot motion (inversion plus eversion)		
Normal or mild restriction (75%-100% normal)	0	85
Moderate restriction (25%-74% normal)	20	15
Marked restriction (Less than 25% normal)	80	0
Ankle-hindfoot stability (anteroposterior, varus-valgus)		
Stable	73	100
Unstable	27	0
Alignment (10 points)		
Good, plantigrade foot, midfoot well aligned	35	66
Fair, plantigrade foot, some degree of malalignment.	40	34
Poor, nonplantigrade foot, severe malalignment	25	0

Figure 10: Table 8 :

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P
B, 2, 8 9.6

AOFA S
SCOR
E.
GROU
P
B, 1, 4
1.8

Figure 11:

.1 Conflict of Interests

The authors declare no potential conflicts of interest. No institutional or financial support was provided for this report.

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